

The Influencing Factors and Development Guidelines of Food Waste in Canteen of Guangxi Vocational University of Agriculture

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Abstract

The objective of this research is to 1) study influencing factors of food waste in canteen of Guangxi Vocational University of Agriculture; and 2) study the development guidelines for countermeasures of food waste in canteen of Guangxi Vocational University of Agriculture. The population included 16,897 enrolled students at Guangxi Vocational University of Agriculture. The sample consisted of 375 randomly selected students who completed a questionnaire, along with 12 key staff members representing three university departments who participated in interviews. The research instruments were a meticulously constructed questionnaire assessing behaviors, awareness, and solutions related to food waste, validated through literature review, expert input, and a structured interview process.

The results were found that lunch is the meal most frequently wasted by students, with over 50% of respondents acknowledging they often waste lunch food. Key factors contributing to food waste identified through statistical analysis of the questionnaire data include large portion sizes, food not tasting good, and lack of peer influence to reduce waste. The interview results aligned with the questionnaire findings, and also emphasized outdated storage practices, menu inflexibility, and lack of performance incentives as driving food waste. Proposed solutions coalesced around awareness campaigns, enhancing chef skills, right-sizing portions, demand-driven preparation, integrating smart tech, and emphasizing educational activities to promote conservation values. In conclusion, a multi-pronged approach addressing preparation, attitudes, and management is needed to significantly reduce food waste among students in university canteens.

Keywords: Food waste; University canteens; Guangxi Vocational University of Agriculture

Introduction

Food waste poses a global challenge with profound economic, environmental, and social impacts, prompting the United Nations' commitment to cut per capita food waste by 50% by 2030 (World Resources Institute, 2019). China, aligning with these goals, launched the "Clean Plate Campaign" in 2013 to combat wasteful practices. Despite these initiatives, China faces staggering food waste, especially in dining establishments. Urban areas witness an average per capita food waste of 93 grams per meal, contributing to a 12% wastage rate (WWFN), equivalent to 17-18 million tons annually sufficient to feed 30-50 million people for a year. This issue intensifies with China's pursuit of prosperity, emphasizing the alarming lack of conservation awareness, notably in university canteens. Guangxi Vocational University of Agriculture's canteens, Nanyuan and Dongyuan, generated 182,000 and 109,000 kilograms of kitchen waste in 2022, respectively (Lande Company). Acknowledging the university's substantial contribution to food waste, this research, employing a questionnaire survey, gains significance.

By investigating specific cases and identifying key factors leading to waste, the study aims to propose actionable strategies that not only reduce food waste at the Guangxi Vocational University of Agriculture but also align with broader national and global sustainability goals. By implementing these policies, the study seeks to curtail post-harvest food losses, uphold national food security, and contribute to broader sustainability goals, echoing the principles of the "Clean Plate Campaign."

Research Objectives

1. To study influencing factors of food waste in the canteen of Guangxi Vocational University of Agriculture.
2. To study the development guidelines for countermeasures of food waste in canteen of Guangxi Vocational University of Agriculture.

Literature Review

1. The Concept of Clean Plate Campaign

According to open news from interne, The Clean Plate Campaign, initiated in January 2013 in China, encourages individuals to minimize food waste by practicing frugality and thriftiness. It promotes the idea of reducing overordering in restaurants, minimizing food waste in cafeterias, and avoiding excessive cooking in kitchens(China Consumer News,2023).

2. The "Anti-Food Waste Law of the People's Republic of China

The "Anti-Food Waste Law of the People's Republic of China" was enacted to prevent food waste, ensure national food security, promote traditional Chinese virtues, practice the core socialist values, conserve resources, protect the environment, and promote sustainable economic and social development, in accordance with the Constitution(State Council of China,2021).

3. The Concept of Food Waste Behavior

Buzby et al. (2002) define dining waste behavior as the act of discarding edible food during consumer meals.

Research Methodology

The research adopted a mixed methods approach utilizing both quantitative and qualitative techniques for comprehensive data collection. The sample population comprised 16,897 students at Guangxi Vocational University of Agriculture, including 7,037 freshman and 9,860 sophomores. A sample of 375 students was selected via simple random sampling to complete a structured questionnaire (Krejcie, R. V., & Morgan, D. W., 1970). Additionally, 12 staff members across 3 relevant university departments participated in interviews to provide qualitative insights.

Questionnaire Design and Administration

The questionnaire contained 36 items across 5 dimensions assessing behaviors, awareness, and solutions related to food waste. It was carefully designed based on a thorough literature review of validated instruments, with expert input to tailor it to the specific research context. A 5-point Likert scale was used to measure agreement levels. The questionnaire was distributed to students online and 375 valid responses were collected.

Reliability and Validity Analysis

Reliability analysis using Cronbach's alpha showed high internal consistency (0.97) for the overall questionnaire. Validity analysis through KMO (0.917) and Bartlett's test confirmed the questionnaire effectively measured the intended constructs.

Interviews

Structured interviews were conducted with 12 staff members holding senior positions related to canteen operations, logistics, security, and student affairs. The interview contained 3 sections to gather suggestions regarding food waste solutions. The experts' insights helped validate and augment the questionnaire design.

Research Scope

Population and Sample

The population comprised 16,897 students at Guangxi Vocational University of Agriculture, including 7,037 freshman and 9,860 sophomores. The sample of 375 students was selected via simple random sampling to complete a structured questionnaire (Krejcie, R. V., & Morgan, D. W., 1970). Additionally, 12 staff members across 3 relevant university departments participated in interviews to provide qualitative insights.

Research Conceptual Framework

This research focuses specifically on investigating the food waste situation among students in university canteens, using Guangxi Vocational University of Agriculture as a case study.

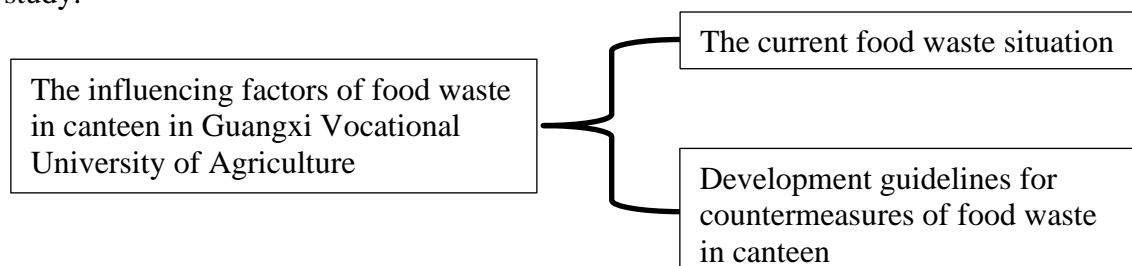


Figure 1 Research Conceptual Framework

Research Results

1. Factors Influencing Food Waste in University Canteens

The analysis of influencing factors indicates that lunch is the meal most frequently wasted by students at Guangxi Vocational University of Agriculture. Though students show moderate awareness regarding food conservation, there are still opportunities to reduce waste further through improved behaviors and attitudes. Key factors contributing to food waste include portion sizes, unwillingness to eat unpalatable food, and lack of peer discouragement against wasting food.

2. Development Guidelines for Solving Food Waste in University Canteens

To address food waste in university canteens, several key solutions emerged, such as: launching awareness campaigns promoting "Clean Plate" initiatives to encourage conscious consumption; enhancing chef skills and training for efficient ingredient use and appetizing dishes; instituting performance evaluations to motivate canteen staff; overhauling management processes like adopting first-in-first-out raw material storage and adjusting menus and portions based on real-time demand; integrating technology for precise meal preparation aligned with actual demand; and educational activities to help students appreciate the value of labor and food conservation.

Table 1 The Average Value (\bar{x}) and Standard Deviation(S.D.) of Behaviors of Food Waste in the University Canteen

	Behaviors of food waste in the university canteen	\bar{x}	S.D.	Level	Order
1.	Students usually leave amount of food uneaten during a typical meal in the university canteen.	1.60	0.88	low	4
2.	Students often take the initiative to inquire about portion sizes or ask for smaller portions in the university canteen.	3.23	1.31	medium	3
3.	If a meal doesn't suit students' taste after a few bites, students would continue eating.	3.38	1.14	medium	2
4.	Students usually persuade and discourage people around from wasting food when noticing them doing so.	3.47	1.14	medium	1

Table 1 presents the mean (M) and standard deviation (S.D.) values for four survey questions assessing behaviors related to food waste in the university canteen. On average, students reported leaving only a low amount of food uneaten during meals ($\bar{x}=1.60$). However, students were only moderately likely to ask for smaller portions ($\bar{x}=3.23$), stop eating unpalatable food (M=3.38), or discourage others from wasting food ($\bar{x}=3.47$).

Table 2 The Average Value (\bar{x}) and Standard Deviation(S.D.) of Types of Food Waste in the University Canteen

	Types of food waste	\bar{x}	S.D.	Level	Order
1.	Staple food	2.84	1.33	medium	1
2.	Meat	2.44	1.40	low	4
3.	Vegetable	2.79	1.27	medium	2
4.	Fruits	2.41	1.39	low	5
5.	Desserts	2.60	1.38	medium	3

Table 2 presents 5 categories of food waste. Staple foods like rice and noodles showed a medium level of waste ($M=2.84$). Meat had the lowest reported waste ($\bar{x}=2.44$). Vegetables ($\bar{x}=2.79$) and desserts ($\bar{x}=2.60$) both demonstrated medium levels of waste. Fruits ranked lowest in waste after meat ($\bar{x}=2.41$,).

Table 3 The Average Value (\bar{x}) and Standard Deviation(S.D.) of Awareness of Food Conservation Among College Students

	Awareness of food conservation among college students	\bar{x}	S.D	Level	Order
1.	Students are aware of activities such as World Food Day, the Clean Plate Campaign, and National Love Grain, Save Food Week.	3.75	1.17	high	1
2.	Students are knowledgeable about the basic information regarding the quantity and stages of food waste in China.	3.61	1.17	high	3
3.	Students possess knowledge about techniques and information related to conserving food.	3.47	1.19	medium	4
4.	Students experience a sense of shame when my meals are wasted without reason.	3.62	1.14	high	2
	Total	3.61	1.17	high	

Table 3 presents students' awareness across 4 areas related to food conservation. Students reported high awareness of food-focused events/campaigns with ($\bar{x}=3.75$). They also showed high awareness of food waste statistics in China, with ($\bar{x}=3.61$). However, their knowledge of food conservation techniques was moderately high, with a lower ($\bar{x}=3.47$). Students did report feeling shame about wasting food unnecessarily, indicated by the high ($\bar{x}=3.62$).

Table 4 The Average Value (\bar{x}) and Standard Deviation(S.D.) of Behaviors of Food Conservation Among University Students

	Behaviors of food conservation among college students	\bar{x}	S.D	Level
1.	When dining out, students are willing to reduce food waste.	3.79	1.15	high
2.	Students are willing to order and consume only what can be eaten to minimize waste.	3.96	1.20	high
3.	Students are willing to pack the leftovers of the meal that haven't be finished.	3.83	1.16	high
4.	When dining out, students are willing to encourage my friends around me not to waste food.	3.97	1.06	high
	Total	3.89	1.14	high

Table 4 presents students' self-reported behaviors around food conservation in dining situations. When dining out, students were highly willing to reduce food waste, with ($\bar{x} = 3.79$). They were also highly willing to only order what they could eat, with ($\bar{x} = 3.96$). Packing uneaten leftovers was also a highly willing behavior, with ($\bar{x} = 3.83$). Students additionally reported a high willingness ($\bar{x} = 3.97$) to encourage dining companions not to waste food.

Table 5 The Average Value (\bar{x}) and Standard Deviation(S.D.) of Solutions to address Food Waste Problem Among University Students

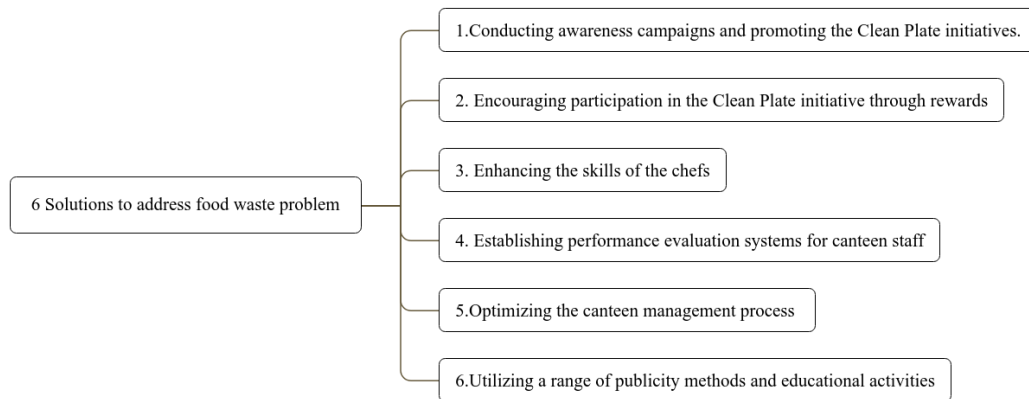
	Solutions to address food waste problem among university students	\bar{x}	SD	Level	Rank
1.	Conduct extensive awareness and education campaigns to promote frugality and conservation culture among students. Implement the "Clean Plate Campaign" to cultivate good saving habits and make saving food a cultural norm.	3.95	1.19	high	2
2.	Utilize various forms of publicity and educational activities, including social practices, to allow students to experience the value of labor and understand the importance of food conservation.	3.93	1.15	high	3
3.	Establish a "Food Security Micro-classroom" to educate students about the current food waste issues in China comprehensively.	3.98	1.18	high	1
4.	Encourage students to participate in the "Clean Plate" initiative through	3.85	1.23	high	9

	Solutions to address food waste problem among university students	\bar{x}	SD	Level	Rank
	activities and rewards, discouraging wasteful behaviors and instilling the concept of saving food.				
5	Regulate the behaviors of canteen operators by providing students with the option to select the amount of food they want, adjust the use of seasonings, and carefully manage the selection of food materials, hygiene conditions, and operating status of the canteens.	3.83	1.08	high	10
6	Enhance the skills of canteen chefs through training, introducing new dish styles, and improving cooking techniques to enhance the taste of dishes and increase the utilization rate of ingredients.	3.88	1.13	high	8
7	Introduce diverse campus dining cultures by offering traditional festival foods and regional cuisines, thus reducing food waste.	3.90	1.25	high	6
8	Establish a performance evaluation system for canteen staff, encouraging skilled and hardworking employees with greater incentives in various aspects, which will lead to improved overall technical proficiency among canteen staff.	3.89	1.14	high	7
9	Cooperate with third-party organizations, such as "food banks" and welfare intermediaries, to handle perishable food materials and kitchen waste, reducing unnecessary food waste.	3.69	1.13	high	19
10	Optimize the canteen management system by adjusting menu varieties and portions, implementing flexible meal delivery based on students' dining situations, and adhering to advanced first-in-first-out principles for raw materials storage and processing.	3.92	1.19	high	4
11	Provide takeaway services for leftovers, implement "Clean Plate" incentives, and actively regulate and	3.81	1.17	high	14

Solutions to address food waste problem among university students		\bar{x}	SD	Level	Rank
	intervene to prevent food waste among students.				
12	Utilize big data, and mobile terminal devices to create a smart canteen that reduces food loss from ordering to dining.	3.80	1.11	high	5
13	Develop an intelligent ordering and payment system, analyze data to ensure precise meal preparation, and reduce food waste caused by miscalculations.	3.80	1.16	high	15
14	Utilize big data to analyze dining patterns and control meal supply frequency, avoiding the waste of food due to prolonged storage.	3.79	1.07	high	17
15	Provide various serving options, such as half portions at half the price, small servings of multiple dishes, and self-service with measured quantities, to offer students more choices and encourage them to balance their diets.	3.82	1.16	high	11
16	Utilize big data to store personal meal consumption data and provide nutritional and cost-saving meal recommendations to students, fostering a healthy eating concept.	3.82	1.19	high	11
17	Encourage students to reduce food waste by recording "Clean Plate" behaviors and rewarding them with discount coupons.	3.78	1.21	high	18
18	Utilize posters, videos, and other forms of media to promote food conservation in canteens.	3.82	1.16	high	11
19	Remind students of their ordering behaviors through "pre-meal reminders" displaying daily waste data, encouraging them to reduce wasteful habits.	3.92	1.13	high	4

Table 5 provides an overview of solutions to address the food waste problem among university students. It includes the average value (\bar{x}) and standard deviation (S.D.) ratings, along with their corresponding levels and ranks.

After an in-depth comparison, it becomes evident that there are six overlapping solutions deemed suitable to tackle the food waste issue at Guangxi Vocational University of Agriculture. These are:



Discussion

This study at Guangxi Vocational University of Agriculture indicates a lack of food conservation awareness among students, linked to societal and educational gaps in thriftiness, as noted by Zhao Ziyi (2022). Factors influencing waste include utensil types, poor taste, and family education, as discussed by Zeng Yongkun (2021) and Wang Yang (2008). Cheng Shengkui and Gao Liwei et al. (2012) analyzed the environmental impact of food waste. The study suggests educational campaigns, skill enhancement for chefs, management improvements, and technological integration in canteens to promote conservation and reduce waste.

The findings of this study reveal that students at Guangxi Vocational University of Agriculture generally lack knowledge about food conservation and have weak awareness and attitudes toward food waste. This could be attributed to the long-term decline of thriftiness in society, as well as insufficient conservation education in schools and families, as noted by Zhao Ziyi (2022). Zhao Ziyi's research found that compared to female students, male students are more likely to feel indignant about others' wasteful behaviors. Family-based education on food conservation is an important factor influencing college students' attitudes toward waste, with a significant positive correlation between family education, thrift culture, and students' behavior of packing leftovers after meals (Zhao Ziyi, 2022). Therefore, it is necessary to create an environment and atmosphere of conservation at the societal, school, and household levels, strengthening education on thriftiness to enhance college students' awareness. This was the same conclusion of Intarasompun, W., Muangnual, P., and Puchatree, N. (2022) and Tosati, S. ., Sitthisopasakul, T., and Intarasompun, W. (2021).

This study also discovered that the types of utensils and dining methods influence the generation of food waste. According to Zeng Yongkun (2021), poor taste is the primary factor leading to food waste among college students, while occasional loss of appetite, excessive portions, high oil content, too many side dishes, limited variety of dishes, and monotonous flavors were secondary reasons. Among different foods, rice was the most wasted, followed by vegetables, noodles, aquatic products, soy products, meat dishes, and mixed meat and vegetable dishes, with eggs being the least wasted. Wang Yang (2008) pointed out that the lack of family education on thriftiness also contributes to waste among university students. Additionally, Cheng Shengkui, Gao Liwei et al. (2012) analyzed the resource and environmental impacts of food waste from the "pre-effect" and "post-effect" perspectives. As the proportion of food

expenditure in total household income decreases, the quantity of food waste increases significantly (Parfitt et al., 2010; Gustavsson et al., 2011). Therefore, students' dining habits and mindsets should be guided, while strengthening conservation education at the school and household levels, fostering an atmosphere where wasting food is shameful to reduce waste across food categories.

This study arrived at consistent conclusions with existing research that food waste behaviors at varying degrees are prevalent among university students, who lack awareness of conservation (Zhao Yunchang et al., 2013; Qiu Pingxiang, 2015). Similar to the findings from University A (Fan Tingting et al., 2015) and University B (Xu Yuan et al., 2011), this research also discovered that some students casually discard half-eaten meals without remorse about wasting food. This could be attributed to the gradual disappearance of China's traditional culture of diligence, thriftiness, and conservation. Deviations in students' civilized moral concepts have led to waste becoming a habitual way of life. Hence, there is a need to further strengthen ideological and moral education for college students, nurturing scientific and civilized attitudes toward food consumption. Additionally, the approach of University C (Shi Jiejie et al., 2015) could be adopted, implementing the "Clean Plate Campaign" in university canteens to guide students to reflect upon and practice plate clearing, establishing scientific dining behaviors, and avoiding comparisons and waste. This was the same conclusion of Wichean Intarasompan, and Jittawisut Wimutipanya (2021).

To address food waste in university canteens, several key solutions emerged, such as: launching awareness campaigns promoting "Clean Plate" initiatives to encourage conscious consumption; enhancing chef skills and training for efficient ingredient use and appetizing dishes; instituting performance evaluations to motivate canteen staff; overhauling management processes like adopting first-in-first-out raw material storage and adjusting menus and portions based on real-time demand; integrating technology for precise meal preparation aligned with actual demand; and educational activities to help students appreciate the value of labor and food conservation.

Similar conclusions were drawn in existing studies. For example, Shi, Wang and Ding (2015) in their study "Analysis and countermeasures of food waste phenomenon among university students" suggested implementing the "Clean Plate Campaign" in university canteens to guide students to reflect upon and practice plate clearing. Wang (2008) in the study "Investigation of food waste phenomenon among university students and countermeasures" proposed enhancing chef skills and training to prepare appetizing dishes that appeal to students' tastes. Zhao, Zeng and Liu (2013) in their research "Investigation and countermeasure research on food waste phenomenon among university students" recommended instituting performance evaluations to motivate canteen staff to reduce waste. Xu, Cao and Zhao (2011) in their "Investigation report on food waste phenomenon among university students in University A" advised adjusting menus and portions based on real-time demand to minimize surplus food. Qiu (2015) in the study "Investigation and countermeasures of food waste among university students" recommended integrating technology for precise meal preparation to match actual consumption. Cheng, Gao, Xu and Cao (2012) in their paper "Thoughts on food waste and its resource and environmental effects in China's catering industry" highlighted educational activities to help students understand the value of food conservation.

Recommendations

1. For Teachers: The teachers or lecturers in the university should incorporate food waste reduction and conservation concepts into their curriculum.

2. For the University: The university should implement the following measures based on the research findings:

2.1 Conduct extensive awareness and education campaigns to promote frugality and conservation culture among students.

2.2 Enhance the skills of canteen chefs through training and improved cooking techniques.

2.3 Establish a performance evaluation system for canteen staff to incentivize efficiency and reduce waste.

2.4 Optimize the canteen management system by adjusting menu varieties, portions, and meal delivery methods.

2.5 Utilize big data for intelligent meal preparation and personalized meal recommendations to promote a healthy eating concept.

3. For Public Policy: Public policies should align with the research recommendations, supporting initiatives that promote food waste reduction and conservation in educational institutions.

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